MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2015/2016

PPP0101 – PRINCIPLE OF PHYSICS

(All Sections / Groups)

29 FEBRUARY 2016
2.30 P.M. – 4.30 P.M.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 8 pages including cover page and appendices with SIX (6) questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
3. Please print all your answer in the Answer Booklet provided.
4. All necessary workings **MUST** be shown.

QUESTION 1 (8 MARKS)

a) The speed of sound v in a gas might plausibly depend on the pressure P, the density ρ, and the volume V of the gas. Use dimensional analysis to determine the exponents $x, y \; and \; z$ in the formula

$$v = C\, P^x\, \rho^y\, V^z,$$

where C is a dimensionless constant.

[6 marks]

b) A cross-country skier skis 1.00 km north and then 2.00 km east on a horizontal snow field. How far and in what direction is she from the starting point?

[2 marks]

QUESTION 2 (10 MARKS)

a) A particle is moving in a straight line so that its position is given by relation $x = (2.10\ \mathrm{m/s^2})t^2 + (2.80\ \mathrm{m})$. Calculate

(i) its average acceleration during the time interval from $t_1 = 3.00\mathrm{s}$ to $t_2 = 5.00\mathrm{s}$,

[4 marks]

(ii) its instantaneous acceleration as a function of time.

[1 mark]

b) A typical jetliner lands at a speed of 257.4 km/h and brakes at the rate of 4.47 m/s^2. If the jetliner travels at a constant speed of 257.4 km/h for 1.0 s after landing before applying the brakes, what is the total displacement of the jetliner between the touchdown on the runway and coming to rest?

[5 marks]

Continued...

QUESTION 3 (8 MARKS)

a) A 10.0 kg box as in **Figure Q3(a)** is pulled along a horizontal surface by a force F_P of 40.0 N applied at 30.0° angle above horizontal. We assume a coefficient of kinetic friction of 0.30. Calculate the acceleration.

[4.5 marks]

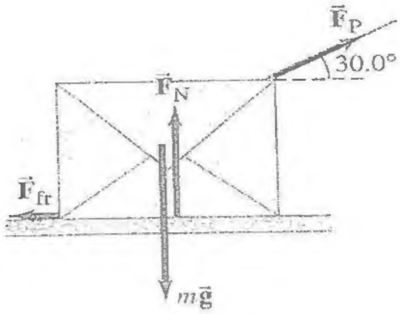

Figure Q3(a)

b) A 0.060 kg tennis ball, moving with a speed of 2.50 m/s, has a collision with a 0.090kg ball initially moving in the same direction at a speed of 1.00 m/s. Assuming perfectly elastic collision, what is the speed and direction of each ball after the collision?

[3.5 marks]

QUESTION 4 (8 MARKS)

An object oscillates with simple harmonic motion along the x-axis. Its displacement from the origin varies with time according to the equation:

$$x(t) = 6.00\text{m} \sin[2\pi t]$$

a) Determine the amplitude, the angular frequency, the frequency, and the period of the motion.

[2 marks]

b) Calculate the velocity and acceleration of the object at any time, t.

[2 marks]

c) Determine the position, velocity and acceleration of the object at t=1.0s.

[1.5 marks]

d) Find the displacement of the body between t=0 and t=1.0s.

[1.5 marks]

e) What is the phase of the motion at t=2.0s?

[1 mark]

Continued...

QUESTION 5 (8 MARKS)

a) Two waves traveling in opposite directions on a string fixed at $x = 0$ are described by the functions

$$y_1 = (0.20m)\sin(2.0x - 4.0t)$$
$$y_2 = (0.20m)\sin(2.0x + 4.0t)$$

(where x is in m, t is in s), and they produce a standing wave pattern. Determine

(i) the function of the standing wave,

[1 mark]

(ii) the amplitude at $x = 0.45$ m,

[1 mark]

(iii) where the other end is fixed (x>0),

[1 mark]

(iv) the maximum amplitude, and where it occurs.

[1 mark]

b) A police siren emits a sinusoidal wave with a frequency of $f_s = 300$ Hz. The speed of sound is 340 m /s.

(i) Find the wavelength of the waves if the siren is at rest in the air.

[1 mark]

(ii) If the siren is moving at 30 m/s, find the wavelengths of the waves ahead of and behind the source.

[3 marks]

Continued...

QUESTION 6 (8 MARKS)

a) A screen is separated from a double-slit source by 1.2 m. The distance between the two slits is 0.030 mm. The second-order bright fringe (n=2) is measured to be 4.5 cm from the centerline. Determine

(i) the wavelength of the light

[2 marks]

(ii) the distance between adjacent bright fringes.

[2 marks]

b) A swimmer has dropped her goggles to the bottom of a pool at the shallow end, marked as 1.0 m deep in **Figure Q6(b)**. But the goggles don't look that deep. How deep do the goggles appear to be when you look straight down into the water? Given the $n_{water} = 1.33$ and $n_{air} = 1.0$.

[4 marks]

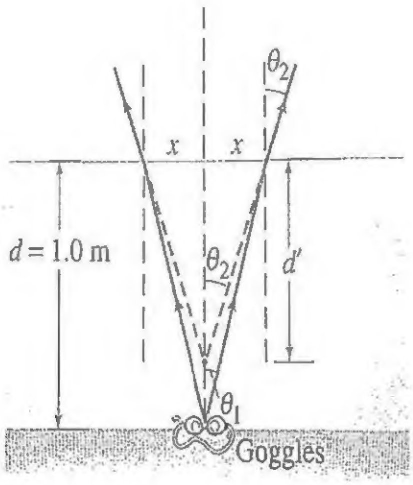

Figure Q6(b)

End of Paper.

LIST OF FORMULA

Differential Rule	Trigonometric Identity
$y = kx^n$ $\frac{dy}{dx} = knx^{n-1}$	$\sin = \frac{opposite}{hypotenuse}$ $\cos = \frac{adjacent}{hypotenuse}$ $\tan = \frac{opposite}{adjacent}$ $\sin\alpha + \sin\beta = 2\cos\left(\frac{\alpha-\beta}{2}\right)\sin\left(\frac{\alpha+\beta}{2}\right)$ $\sin(\alpha-\beta) + \sin(\alpha+\beta) = 2\sin\alpha\cos\beta$

NEWTONIAN MECHANICS

$v = \frac{\Delta x}{\Delta t}$ $a = \frac{\Delta v}{\Delta t}$ $v = v_o + at$ $x - x_o = v_o t + \frac{1}{2}at^2$

$v^2 = v_o^2 + 2a(x - x_o)$ $x - x_o = \left(\frac{v_o + v}{2}\right)t$

$v = v_o + gt$ $y - y_o = v_o t + \frac{1}{2}gt^2$ $v^2 = v_o^2 + 2g(y - y_o)$ $y - y_o = \left(\frac{v_o + v}{2}\right)t$

$W = Fs\cos\theta$ $W = mg$ $\sum F = F_{net} = ma$ $f_s \leq \mu_S F_N$

$f_k = \mu_K F_N$ $p = mv$ $\sum F = \frac{\Delta p}{\Delta t}$

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ $m_1u_1 + m_2u_2 = (m_1 + m_2)\,v$ $P = \frac{W}{t} = \frac{E}{t} = \frac{Fd}{t} = F\bar{v}$

$K = \frac{1}{2}mv^2$ $PE_s = \frac{1}{2}kx^2$ $F_s = -kx$ $PE_G = mgy$

$v_{circular} = \frac{2\pi r}{T}$ $a_c = \frac{v^2}{r}$ $F_g = G\frac{m_1m_2}{r^2}$ $U_g = -G\frac{m_1m_2}{r}$

$T^2 = K_s r^3$ $T_s = 2\pi\sqrt{\frac{m}{k}}$

Spring with mass, Simple pendulum,

$\omega = \sqrt{\frac{k}{m}}$ $\omega = \sqrt{\frac{g}{l}}$ $T_p = 2\pi\sqrt{\frac{l}{g}}$ $T = \frac{2\pi}{\omega} = \frac{1}{f}$

Cosine Wave: $x = A\cos\omega t$, $v = -\omega A\sin\omega t$, $a = -\omega^2 A\cos\omega t$

Sine Wave: $x = A\sin\omega t$, $v = \omega A\cos\omega t$, $a = -\omega^2 A\sin\omega t$

WAVES AND OPTICS

$v = f\lambda$ $\quad \omega = 2\pi f$ $\quad n = \dfrac{c}{v}$ $\quad n_1\sin\theta_1 = n_2\sin\theta_2$

$\sin\theta_c = \dfrac{n_2}{n_1}$ $\quad \dfrac{1}{f} = \dfrac{1}{d_o} + \dfrac{1}{d_i}$ $\quad M = -\dfrac{d_i}{d_o} = \dfrac{h_i}{h_o}$ $\quad f = \dfrac{R}{2}$

$d\sin\theta_{\max} = m\lambda$ $\quad a\sin\theta_{\min} = m\lambda$ $\quad d\sin\theta_{\min} = (m+\frac{1}{2})\lambda$

$y_{bright} = \dfrac{m\lambda L}{d}$ $\quad y_{dark} = (m+\frac{1}{2})\dfrac{\lambda L}{d}$ $\quad I = \dfrac{P}{A}$ $\quad \beta = 10\log_{10}\dfrac{I}{I_o}$

$f' = f\left(\dfrac{v \pm v_o}{v \mp v_s}\right)$ $\quad y(x,t) = A\sin(kx \pm \omega t + \phi)$

Wave Type:

$$y(x,t) = 2A\cos\left(\frac{\phi}{2}\right)\sin(kx - \omega t - \frac{\phi}{2})$$

$$y(x,t) = 2A\sin kx \cos\omega t$$